IN THE CLAIMS

This listing of the claim will replace all prior versions and listings of claim in the present application.

Listing of Claims

Claims 1-20 (canceled)

21. (currently amended)A communication apparatus connectable to a network which permits communication across a plurality of hierarchical layers, comprising:

(i) lower-layer apparatuses which are connected with communication lines of a lower layer and communication lines of an upper layer and have means for line switching in the lower layer,

wherein the lower layer is a lower layer as defined by the layer hierarchy of the Open System Interconnection (OSI) reference model as set by the International Standards Organization (ISO) and the upper layer is an upper layer as defined by the layer hierarchy of the OSI reference model as set by the ISO; and

(ii) upper-layer apparatuses which are connected with the communication lines of the upper layer and have means for line switching in the upper layer,

wherein said communication apparatus detects line failure and coordinates line switching by the line-switching means of the lower and upper-layer apparatuses by using failure information on the lower and upper-layer communication lines.

22. (previously presented) A communication apparatus according to claim 21, wherein each lower-layer apparatus has a coordinated-switching device of

a coordinated-switching function or is connected with coordinated-switching means through an interface.

23. (previously presented) A communication apparatus according to claim 21, further comprising:

a switching mode that causes the line-switching means of the upper-layer apparatuses to begin switching when the line switching means of the lower-layer apparatuses have finished switching.

24. (currently amended)A communication apparatus connectable to a network which permits communication across a plurality of hierarchical layers, comprising:

(i) lower-layer apparatuses which are connected with communication lines of a lower layer and communication lines of an upper layer and have means for line switching in the lower layer wherein the lower layer is a lower layer as defined by the layer hierarchy of the Open System Interconnection (OSI) reference model as set by the International Standards Organization (ISO) and the upper layer is an upper layer as defined by the layer hierarchy of the OSI reference model as set by the ISO;

(ii) upper-layer apparatuses which are connected with the communication lines of the upper layer and have means for line switching in the upper layer; and

means for detecting line failure and determining the order of switching by the switching means of the lower and upper-layer apparatuses by using failure

information on the lower and upper-layer communication lines, and restoring faulty communication lines.

25. (previously presented) A communication apparatus according to claim 24, wherein said means of the lower-layer apparatuses has a coordinated-switching device or a coordinated-switching function or is connected with coordinated-switching means through an interface.

26. (currently amended)A communication apparatus connecatable to a network which permits communication across a plurality of hierarchical layers, comprising:

(i) lower-layer apparatuses which are connected with communication lines of a lower layer and communication lines of an upper layer and have means for line switching in the lower layer wherein the lower layer is a lower layer as defined by the layer hierarchy of the Open System Interconnection (OSI) reference model as set by the International Standards Organization (ISO) and the upper layer is an upper layer as defined by the layer hierarchy of the OSI reference model as set by the ISO;

(ii) upper-layer apparatuses which are connected with the communication lines of the upper layer and have means for line switching in the upper layer;

means for detecting line failure and collects failure information on the lower and upper-layer communication lines, identifying one or more faulty lines of the lower or the upper layer and locates the site of occurrence of failure by using the collected failure information, and identifying, by using the information on the faulty

communication lines and the site of occurrence of failure, lower and upper-layer apparatuses which are required to make line switching in order to restore the faulty communication lines; and

means for determining the order and the timing of line switching by the line-switching means of the identified lower and upper-layer apparatuses.

27. (previously presented) A communication apparatus according to claim 26, wherein said means in the lower-layer apparatuses has a coordinated-switching device or a coordinated-switching function or is connected with coordinated-switching means through an interface.

28. (currently amended)A communication apparatus connectable to a network which permits communication across a plurality of hierarchical layers, comprising:

(i) lower-layer apparatuses which are connected with communication lines of a lower layer and communication lines of an upper layer and have means for line switching in the lower layer wherein the lower layer is a lower layer as defined by the layer hierarchy of the Open System Interconnection (OSI) reference model as set by the International Standards Organization (ISO) and the upper layer is an upper layer as defined by the layer hierarchy of the OSI reference model as set by the ISO;

(ii) upper-layer apparatuses which are connected with the communication lines of the upper layer and have means for line switching in the upper layer; and

means for transmitting a switching-inhibit signal to the upper layer apparatuses when any lower-layer apparatus has detected line failure, identifying faulty lines of the lower and upper layers and locates the site of occurrence of failure by using failure information collected on the lower and upper-layer communication lines; and

coordinates line switching by the lower- and upper layer apparatuses by using said collected failure information on the lower and upper-layer communication lines.

29. (previously presented) A communication apparatus according to claim 28, wherein when the lower-layer apparatuses have detected line failure, a switching inhibit signal is transmitted to the upper-layer apparatuses first and then the failure detection is notified to them.

30. (previously presented) A communication apparatus according to claim 28, wherein each lower-layer apparatus has a coordinated-switching device or a coordinated-switching function or is connected with coordinated-switching means through an interface.

31. (currently amended)A communication apparatus connectable to a network which permits communication across a plurality of hierarchical layers, comprising:

(i) lower-layer apparatuses which are connected with communication lines of a lower layer and communication lines of an upper layer and have means for line switching in the lower layer,

wherein the lower layer is a lower layer as defined by the layer hierarchy of the Open System Interconnection (OSI) reference model as set by the International Standards Organization (ISO) and the upper layer is an upper layer as defined by the layer hierarchy of the OSI reference model as set by the ISO; and

(ii) upper-layer apparatuses which are connected with the communication lines of the upper layer and have means for line switching in the upper layer;

means for transmitting a switching inhibit signal to the upper layer apparatuses when any lower layer apparatus has detected line failure, identifying one or more faulty lines of the lower or the upper layer and locates the site of occurrence of failure by using failure information collected on the lower and upper-layer communication lines, canceling the switching inhibit signal to the upper-layer apparatuses when no lower-layer communication line has been found faulty but any of the upper layer communication lines has been found faulty, and determining, by using failure information on the lower and upper layer communication lines, which line switching means of the lower and upper layer apparatuses should make switching in order to secure a largest number of normal upper-layer communication lines, or in order to restore high-priority lines rather than low priority lines or in order to secure a largest number of signal channels, in case that any of the lower layer communication lines has been found faulty; and

means for causing line switching in the lower layer first and then canceling the switching inhibit signal to the upper layer apparatuses in case that switching is to take place in both the lower and upper layers in accordance with said determination.

32. (previously presented) A communication apparatus according to claim 31, wherein when the lower layer apparatuses have detected line failure, a switching inhibit signal is transmitted to the upper layer apparatuses first and then the failure detection is notified to them.

33. (previously presented)A communication apparatus according to claim 31, wherein each lower layer apparatus has a coordinated switching device or a coordinated switching function or is connected with coordinated switching means through an interface.

34. (currently amended)A communication system comprising:

first and second upper-layer apparatuses;

first, second, third, and fourth lower-layer apparatuses,

wherein each of said upper-layer and lower-layer apparatus having line-switching means;

wherein said upper layer and lower layer apparatus are interconnected by a network having a plurality of communication lines at a plurality of hierarchical layers including an upper layer and a lower layer,

wherein the lower layer is a lower layer as defined by the layer hierarchy of the Open System Interconnection (OSI) reference model as set by the International Standards Organization (ISO) and the upper layer is an upper layer as defined by the layer hierarchy of the OSI reference model as set by the ISO;

(i) the first and second upper layer apparatuses are connected to each other through ~~a~~ first and ~~a~~ second upper layer communication ~~line~~ lines between which communication can be switched,

(ii) wherein the first and second lower layer apparatuses are connected to each other through ~~a~~ first and ~~a~~ second lower-layer communication ~~line~~ lines between which communication can be switched, each of said first and second lower layer communication ~~line~~ lines being multiplexed to accommodate one or more upper layer communication lines,

(iii) wherein the third and fourth lower layer apparatuses are connected to each other through ~~a~~ third and ~~a~~ fourth lower layer communication ~~line~~ lines between which communication can be switched, each of said third and fourth lower layer communication ~~line~~ lines being multiplexed to accommodate one or more upper layer communication lines,

(iv) wherein the first upper layer communication line connects the first upper layer apparatus with the first lower layer apparatus and the second upper layer apparatus with the second lower layer apparatus,

(v) wherein the second upper layer communication line connects the first upper layer apparatus with the third lower layer apparatus and the second upper layer apparatus with the fourth lower layer apparatus,

wherein a switching inhibit signal is transmitted to the upper layer apparatuses when the lower layer apparatuses have detected a line failure,

wherein one or more faulty lines of the lower or the upper layer are identified and the site of occurrence of the line failure is located by using failure information on the lower and upper layer communication lines,

wherein the switching inhibit signal to the upper layer apparatuses is canceled when no lower layer communication line has been found faulty but any of the upper layer communication lines has been found faulty,

wherein which line switching means of the lower and upper layer apparatuses should make switching is determined, based on failure information on the lower and upper layer communication lines, in order to secure a largest number of normal upper layer communication lines, or in order to restore high priority lines rather than lower priority lines, or in order to secure a largest number of signal channels, in case that any of the lower layer communication lines has been found faulty; and

first means for causing line switching in the lower layer first and then canceling the switching inhibit signal to the upper layer apparatuses, when the switching is to take place in both the lower and upper layers in accordance with said determination.

35. (previously presented) A communication system according to claims 34 wherein said first means chooses a set of the line-switching means which has the smallest number of times of switching if two or more sets of line-switching means are found to bring about one and the same result for the proposition of

securing a largest number of normal upper-layer communication lines, restoring high-priority lines rather than low-priority lines, or securing a largest number of signal channels chooses a set of line-switching means requiring no line switching in the lower layer, if any, and the switching-inhibit signal to the upper-layer apparatuses is cancelled if two or more sets of line-switching means are found to have one and the same smallest number of times of switching, and causes line switching in the lower layer first and then cancels the switching-inhibit signal to the upper-layer apparatuses if there is not a set of line-switching means which requires no line switching in the lower layer.

36. (previously presented) A communication system according to claims 34, wherein, when the lower-layer apparatuses have detected line failure, a switching-inhibit signal is transmitted to the upper-layer apparatuses first and then the failure detection is notified to them.

37. (currently amended)A communication system comprising:

a plurality of lower-layer apparatuses;

a plurality of upper-layer apparatuses,

wherein said upper layer and lower layer apparatus are interconnected by a network having a plurality of communication lines at a plurality of hierarchical layers including an upper layer and a lower layer,

wherein the upper-layer apparatuses belong to ~~a~~the upper layer which is ~~upper~~ higher than ~~a~~the lower layer to which the lower-layer apparatuses belong, each apparatus having line-switching means,

wherein the lower layer is a lower layer as defined by the layer hierarchy of the Open System Interconnection (OSI) reference model as set by the International Standards Organization (ISO) and the upper layer is an upper layer as defined by the layer hierarchy of the OSI reference model as set by the ISO;

lower-layer communication lines, connected between the lower-layer apparatuses, each lower-layer communication line being multiplexed to accommodate one or more upper-layer communication lines;

upper-layer communication lines, connected between the upper-layer apparatuses, going through the lower-layer apparatuses,

wherein a switching-inhibit signal is transmitted to the upper-layer apparatuses when any of the lower-layer
apparatuses has detected line failure,

wherein one or more faulty lines of the lower or the upper layer are identified and the site of occurrence of failure is located based on failure information on the lower- and upper-layer communication lines,

wherein the switching-inhibit signal to the upper-layer apparatuses is cancelled when no lower-layer communication line has been found faulty but any of the upper-layer communication lines has been found faulty,

wherein which line-switching means of the lower-and upper-layer apparatuses should make switching is determined, based on failure information on the lower- and

upper-layer communication lines, in order to secure a largest number of normal upper-layer communication lines, or in order to restore high-priority lines rather than low-priority lines, or in order to secure a largest number of signal channels, in case that any of the lower-layer communication lines has been found faulty; and

first means for causing line switching in the lower layer first and then canceling the switching-inhibit signal to the upper-layer apparatuses, in case that switching is to take place in both the lower and upper layers in accordance with said determination.

38. (previously presented) A communication system according to claim 37, wherein, when no lower-layer communication line has been found faulty but any of the upper-layer communication lines has been found faulty, the switching-inhibit signal to the upper-layer apparatuses is cancelled first and then the failure detection is notified to them.

39. (new) A communication apparatus which is connected with a network, which permits communication across a plurality of hierarchical layers, comprising:

(a) a lower layer which is based on the layer hierarchy of the Open System Interconnection (OSI) reference model defined by the International Standards Organization (ISO) and an upper layer which is based on the layer hierarchy of the OSI reference model defined by the ISO;

(b) lower layer apparatuses which are connected with communication lines of said lower layer and communication lines of said upper layer, each lower layer apparatus having means for line switching in said lower layer;

(b) upper layer apparatuses which are connected with the communication lines of said upper layer and have means for line switching in said upper layer,

wherein said lower layer apparatus transmits a switching inhibit signal to the upper layer apparatus when said lower layer apparatus has detected a line failure, in a lower or the upper layer and locates the site of occurrence of failure by using failure information collected on the lower and upper layer communication lines, cancels the switching inhibit signal to the upper layer apparatus when no lower layer communication line has been found faulty but an upper layer communication line has been found faulty; and

(d) means for causing line switching in the lower layer first and then canceling the switching inhibit signal to the upper layer apparatuses when switching is to take place in both the lower and upper layers in order to restore or recover the line failure.

40. (new) A communication apparatus which is connected with a network which permits communication across a plurality of hierarchical layers, comprising:

(a) a lower layer which is based on the layer hierarchy of the Open System Interconnection (OSI) reference model defined by the International Standards Organization (ISO) and an upper layer which is based on the layer hierarchy of the OSI reference model defined by the ISO;

(b) lower layer apparatuses which are connected with communication lines of said lower layer and communication lines of said upper layer, each lower layer apparatus having means for line switching in said lower layer; and

(c) upper layer apparatuses which are connected with the communication lines of said upper layer and have means for line switching in said upper layer,

wherein said communication apparatus detects line failure, determines line switching order or sequence by using failure information on the lower and upper layer communication lines; and

causes line switching in the lower layer first while it inhibits the line switching in the upper layer and then the line switching in the upper layer while it inhibits the lien switching in the lower layer.